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TECHNICAL EVALUATION PLAN
FT. SHERIDAN RI/FS
DATA EVALUATION PROCEDURES:
USE OF BACKGROUND DATA

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13. ABSTRACT *(Maximum 200 words)*

This document sets out the background, risk-based, and ecological screening processes to determine if specific surplus operable unit study areas can be recommended for No Further Action. Study areas passing these screening processes will be recommended for No Further Action. Study areas failing these screening processes will be carried through to the Remedial Investigation/Baseline Risk Assessment (RI/BRA) for further evaluation.

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1.0 Introduction

To reduce the number of study areas to be evaluated in the Remedial Investigation/Feasibility Study (RI/FS), and to facilitate the transfer of property where no removal or remedial action is required, the Base Realignment and Closure (BRAC) Cleanup Team (BCT) agreed to develop a risk-based screening process. The risk-based screening process uses conservative values that represent levels of constituents below which there is no concern under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In order to facilitate this screening process, it is necessary to develop a statistical procedure for the determination of background concentrations for the Ft. Sheridan Surplus Operable Unit (OU) as well as develop a procedure for using this background data as an evaluation baseline in two situations. The first situation is in deciding which study areas are to proceed on to the risk-based screening process and which study areas require no further response under CERCLA. The second situation occurs in the Remedial Investigation/Baseline Risk Assessment (RI/BRA) Report in determining if the concentrations detected in the study areas are statistically significantly above background and in identifying constituents of potential concern (COPCs).

The purpose of this document is to specify how background sampling and analysis data will be used in the study area screening and RI/BRA data evaluation processes for Fort Sheridan and to outline how the risk-based screening process will be performed. These issues were discussed generally in Section 6.0 (Data Evaluation and Technical Memorandum) of the Final Sampling and Analysis Plan for the Surplus Operable Unit (ESE, 1995a). Background data have been collected in accordance with the Final Sampling and Analysis Plan for Background Sampling (BSAP) (ESE, 1995b). Prior BCT approval of the background comparative database will be obtained before the screening process is performed.

Only screening for protection of human health is addressed by the risk-based screening. For those study areas passing the risk-based screening, a screening of potential risks to ecological receptors will be presented in the Technical Memorandum. For those study areas failing the risk-based screening and passing on to the RI, a qualitative and/or quantitative ecological risk assessment will be performed as part of the RI/BRA Report.

1.1 Objectives

The objectives of background data collection and evaluation and risk-based screening processes are:

(a) to identify study areas where mission activities have left residues of potentially hazardous constituents (COPCs);

(a)   to identify study areas where mission activities have left residues of potentially hazardous constituents (COPCs);

(b)   to eliminate from further investigation, study areas where no COPCs are significantly elevated above site-specific background levels or risk-based screening levels;

(c)   to determine if study area constituent concentrations are statistically greater than background concentrations as part of the RI; and

(d)   to identify study area specific COPCs to be addressed by the BRA.

Evaluation of data and comparison of study area data to background data will proceed in a phased approach to achieve efficient use of resources. Simple screening methods will be used to identify study areas where no COPCs are significantly elevated, followed by more rigorous statistical methods to identify study area constituent exceedances of background in the RI and specific COPCs for the BRA at study areas that fail the initial screening methods.

These procedures are intended to be in conformance with Chapter 5: Data Evaluation of the Risk Assessment Guidance for Superfund (RAGS) Human Health Evaluation Manual (Part A) (EPA, 1989a).

1.2 Initial Data Evaluation

In accordance with Chapter 5 of RAGS, Phase I and Phase II RI data, validated in accordance with the Overall Quality Assurance Project Plan (OQAPP) (ESE, 1995a), will be gathered and sorted by medium. As discussed in the BSAP (1995b), samples were collected previously in Phase I to represent background conditions at the installation. However, due to the sample locations, these Phase I data are not suitable for use in an installation-wide background database. Therefore, only Phase II data will make up the background data set. The Phase II background data collection effort was intended to be sufficient for determination of background without use of the Phase I data.

Because the data collected in Phase II were collected in accordance with the approved sampling and analysis plans (ESE, 1995b; ESE, 1995c), it is assumed that these data are useable, and that the most significant data evaluation step would be to evaluate the data with respect to field/equipment blanks, trip blanks, and internal laboratory quality control samples. For instance, if a constituent is detected in blank samples associated with a specific set of field data, it will be assumed that the detection limit is five times the level observed in the blank (ten times if the COPC is a common laboratory contaminant) (EPA, 1989b).

In addition, it is possible that samples collected as potential background samples will be excluded from the background data set prior to comparison with study area data sets. The background data will be reviewed before seeking concurrence from reviewing agencies that the data are representative of environmental media unaffected by mission activities.

1.3 Expected Characteristics of the Data Sets

Sample Size: The Phase II background data set will consist of 5 to 28 samples, depending on the environmental medium. Groundwater, surface water, and sediment media will have 8, 5, and 5 background samples, respectively. Twenty-eight Phase II background soil samples were collected and analyzed in accordance with the BSAP. It may be appropriate to separate these samples into several subsets according to soil type and/or sample depth. Consequently, each subset is likely to have 5 to 10 samples. Each background data set (e.g., surface water) is assumed to represent background conditions for that medium at each study area.

The size of individual study area data sets will vary substantially. A few study areas will have a larger number of samples than their comparison background data set. For example, Landfill 2 will have 25 soil samples and 16 groundwater samples; Landfills 3 & 4 will have 34 soil samples; CSA 1, 18 soil samples; CSA 3, 21 soil samples; VES Area 1, 20 soil samples, Building 43, 21 soil samples. These study area soil data sets may also be separated into subsets according to the same factors (soil type and sample depth) to be considered in evaluating the background data sets.

On the other hand, a number of study areas will have fewer samples, by medium, than the comparison background data sets. A few study area data sets will have only one sample per medium, (e.g., Building 43 sediments, Building 173 surface soils, McArthur Loop Drain surface waters, Building 126 groundwaters, etc.).

Frequency of Detection: Some analytes, such as metals, are likely to be detected in virtually every sample, while other chemicals may be detected infrequently (e.g., $<< 50$ percent hits).

Distribution: Many environmental data sets have been shown to be lognormally distributed. Some data sets may appear to be drawn from a normal population. The small sample size of most of the data sets will preclude significant inferences regarding goodness of fit to any parametric distribution.

1.4 Chemical Class

Metals are naturally occurring, and many metals are detectable in soils and waters unaffected by anthropogenic sources. Pesticides are anthropogenic, but some pesticides are so widespread and persistent that they can be detected at locations far from their point of use or disposal. Polynuclear aromatic hydrocarbons occur naturally as the result of combustion (e.g., forest fires), or may be deposited from airborne emissions unrelated to activities at Fort Sheridan (e.g., from vehicles or power plants). At this time, however, a presumption will be made that organic chemicals detected in study area samples are significantly elevated and, thus, COPCs. The procedures described in this document for comparison to background data will be applied only to inorganics. The Army reserves the right to review this presumption if any organic chemical is detected in multiple background samples. In addition, potential risks (if any) due to anthropogenic sources will be discussed in the RI/BRA Report and Feasibility Study, as necessary.

2.0 Study Area Screening

The study area screening process to be used involves two steps. The first step is a comparison to background values. The second step is a comparison to risk-based levels. The specifics of this two step process are presented below.

2.1 Screening Against Background

The objectives of the study area screening process are to identify those study areas that must be addressed in the RI, and, conversely, which study areas may be identified for No Further Action and dropped from further investigation. This evaluation can be characterized as a screening level analysis, with more rigorous evaluation planned as part of the RI for those study areas and COPCs that are carried forward. Considering these objectives, the screening procedure should avoid false negative errors (i.e., concluding that a study area is not adversely affected when, in fact, it is). False positive errors (i.e., carrying a study area forward when it is, in fact, not adversely affected) on the other hand, are less of a problem because they can be corrected in the RI/BRA.

A simple and widely accepted method for identifying sampling locations that may exceed background is the upper tolerance limit method (EPA, 1989b). This method determines whether a sample exceeds the 95th percentile of the background distribution, with 95 percent confidence. Although useful in identifying unusually high concentrations at sampling locations that may indicate mission-related contamination, this method may result in a high percentage of false positives if study area data sets have a large number of samples. Even an unaffected study area will likely have some relatively high concentration locations due to natural variation. As the number of samples collected at a study area increases, it becomes more and more likely that one sample will exceed the upper tolerance limit. If even one sample from a study area exceeds the upper tolerance limit, the study area will be carried forward to the risk-based screening. Failure of the upper tolerance limit test is not conclusive that the study area has elevated constituent concentrations, although the method is useful in identifying hot spots.

Prior to calculating the upper tolerance limits, background data sets will be tested to determine whether they appear more likely to have been sampled from a normal or a lognormal distribution using the Shapiro and Wilk W test (Gilbert, 1987, and USEPA, 1989b, Section 4.2). This test is recommended by USEPA Guidance (USEPA, 1989b) and is a conservative method for testing distributional assumptions. Samples less than the analytical detection limit will be replaced with 1/2 the detection limit. Shapiro and Wilk will be applied to both the actual values and the natural logarithms of the actual values. If W (i.e., the calculated measure of fit) is larger when applied

to the actual values, the data will be assumed to be normally distributed, otherwise lognormality will be assumed.

Upper tolerance limits for 95 percent coverage and a tolerance coefficient of 95 percent will be calculated, using actual values or logarithms (as indicated by the Shapiro and Wilk W test) following the procedure presented in USEPA (1989b). Each sample from each study area will be compared with the upper tolerance limit, and study area values exceeding the upper tolerance limit will be highlighted as potentially affected by mission activities. If any study area samples exceed the upper tolerance limit for any constituent, the study area will be carried forward to the risk-based screening (see Section 2.2).

The study area will be eliminated from further investigation if (1) no organic constituents were detected, and (2) no inorganic constituents exceed the background screen as defined above. From Section 1.4, detection of organic constituents is presumed to indicate that the constituent is significantly elevated above background. If either (1) or (2) are not true (i.e., at least one chemical exceeds background), the maximum concentrations of exceeding constituents will be compared to risk-based screening concentrations.

2.2 Risk-Based Screening

Risk-based screening will be performed for each constituent that fails the background screening comparison as defined in Section 2.1. Concentrations will be compared with the following risk-based screening levels:

- Soil and Sediment
  The most conservative of the pathway-specific (inhalation, ingestion) USEPA Soil Screening Levels (SSLs),
  USEPA Region IX Preliminary Remediation Goals (PRGs), and the IEPA Tiered Approach to Cleanup Objectives (TACO) Tier 1-Residential Migration to Class II Groundwater Values
- Groundwater
  Illinois Administrative Code (IAC) Part 620 Groundwater Standards
- Surface Water
  35 IAC Part 302 Illinois General Use Water Quality Standards
  35 IAC Part 302, Subpart E - Lake Michigan Water Quality Standards

The SSLs were developed by USEPA as a screening tool to facilitate the RI process. Generally, if constituent concentrations fall below these generic levels, then no further study or action is warranted for residential use of that area. The PRGs were developed by USEPA Region IX using

current USEPA toxicological data with reasonable maximum exposure factors to estimate concentrations that are generally agreed to be "safe" for humans. The TACO values were developed by IEPA to provide a risk-based tiered approach for protection of human health and the environment under programs administered by IEPA. If risk-based screening levels have not been published in any of the above-referenced sources, but sufficient toxicological data are available to calculate either a SSL, PRG, or TACO in accordance with methods published by USEPA and IEPA, a screening level may be estimated in accordance with those methods.

The risk-based screening process is presented in Figure 2-1. If a study area has one or more constituents that fail the comparison to background test of Section 2.1 and the relevant risk-based screening levels, then the study area will be considered for inclusion in the RI and BRA. If a study area passes the comparison to background test or has one or more constituents that fail the comparison to background test of Section 2.1 but passes the relevant risk-based screening level, then the study area will be considered for No Further Action. The results of the risk-based screening process will be evaluated for each study area. Depending on the number, type, and concentration of the study area constituents that fail the risk-based screening process, study areas may be recommended for No Further Action even if a few constituents fail the process. Such a recommendation is subject to BCT review and will be fully documented in the Technical Memorandum. Such a recommendation will also depend on the total number of samples collected at the study area as well as the concentrations of the "failing" constituents in the remaining samples.
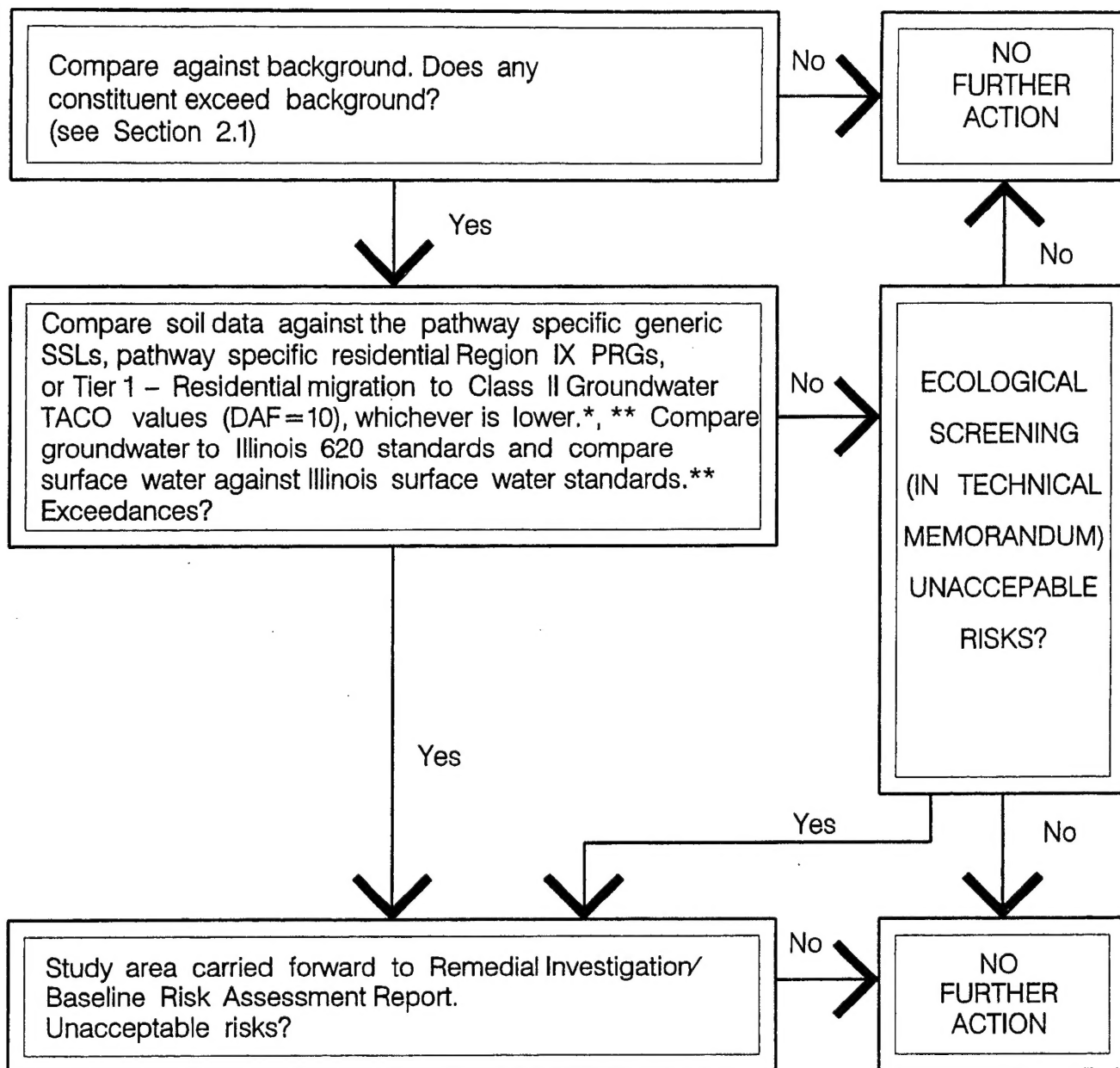
2.3 Ecological Screening

Those study areas recommended for No Further Action as a result of the above risk-based screening will undergo a qualitative ecological screening in the Technical Memorandum. In this screening, the study areas will be evaluated for significant or sensitive biological receptors, or pathways to significant or sensitive biological receptors. Study areas adjacent to or with pathways to ravines, bluffs, shoreline, and Lake Michigan are anticipated to be the more likely candidates for such receptors or pathways. Study areas that do not have significant or sensitive receptors or pathways to such receptors will be identified for No Further Action.

Data will be reviewed for those study areas identified above as having significant or sensitive biological receptors, or pathways to significant or sensitive biological receptors. COPCs for ecological receptors will be tentatively identified based upon persistence and tendency to bioaccumulate, media and extent of contamination, potential pathways of exposure, ecotoxicity for endpoints relevant to populations, and other factors. Environmental data for surface water and sediments will be compared to relevant ecotox screening values available from USEPA. In

accordance with USEPA Region V Biological Technical Assistance Group guidance, total metal concentrations will be used in the screening procedure (USEPA, 1996). Where screening values are not available from USEPA, values from other sources will be used (e.g., Ontario Ministry of the Environment and Energy). In the absence of readily available benchmarks for screening, professional judgement will be exercised.

The evaluation will be based upon generally qualitative or screening level evaluations, but will be conservative. Study areas that have a significant potential for adverse effects to ecological receptors based upon this assessment will be referred to the RI/BRA for quantitative evaluation. Study areas determined not to have a significant potential for adverse effects will be identified for No Further Action.

Compare against background. Does any
constituent exceed background?
(see Section 2.1)

No → NO FURTHER ACTION

Yes ↓

Compare soil data against the pathway specific generic
SSLs, pathway specific residential Region IX PRGs,
or Tier 1 – Residential migration to Class II Groundwater
TACO values (DAF=10), whichever is lower.*, ** Compare
groundwater to Illinois 620 standards and compare
surface water against Illinois surface water standards.**
Exceedances?

No → ECOLOGICAL SCREENING (IN TECHNICAL MEMORANDUM) UNACCEPABLE RISKS?

No ↑ NO FURTHER ACTION

Yes ↓

Yes (from Ecological Screening)

No (from Ecological Screening) ↓

Study area carried forward to Remedial Investigation/
Baseline Risk Assessment Report.
Unacceptable risks?

No → NO FURTHER ACTION

*   In cases where no risk–based level has been published for
     a COPC, but sufficient toxicological data are available, a
     screening level may be estimated.

** In cases where the analytical detection limit is higher than the
     risk–based level, the consituent concentrationl will equal the
     detection limit.

Figure 2–1
RISK–BASED SCREENING PROCESS
TECHNICAL EVALUATION PLAN

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3.0 Identification of COPCs for the BRA

Study areas that fail the screening tests of Section 2 will be carried forward to the RI/BRA. Available data relevant to each study area will be evaluated. Using relevant data, constituent concentrations above background and COPCs will be identified for the study areas using more rigorous statistical procedures to determine if the constituents are significantly elevated above site-specific background.

Recommended methods are based on "Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities" (USEPA, 1989b), as recommended by RAGS. These methods were recommended for RCRA compliance monitoring to determine if downgradient wells at a RCRA facility were significantly elevated above background (upgradient) wells. The methods are, however, equally valid for hypothesis testing with soils, sediment, or surface water data. The methods were selected considering small sample size, low frequency of detection (<50 percent), and uncertainty regarding the underlying distribution of the data (e.g., normality). The method is as follows:

1. Edit data sets with unusually high detection limits:
    (a) Replace values listed as less than the detection limit with one-half the detection limit (EPA, 1989a).
    (b) Determine goodness of fit to normal and lognormal distributions, using the Shapiro and Wilk W test (Gilbert, 1987). The Shapiro and Wilk test can be used to test lognormality by taking the natural logarithms of the data, and then testing for normality.
    (c) If the coefficient of variation (standard deviation divided by the mean) is less than 1.2, use normal procedures (e.g., equation 11.6 of Gilbert, 1987; see also Gilbert, p. 164, for the coefficient of variation criterion).
    (d) If the coefficient of variation exceeds 1.2, select the distribution type (normal or lognormal) that best fits the data according to the Shapiro and Wilk W test. Then use Gilbert equation 11.6 for normal, or Gilbert equation 13.13 for lognormal, to calculate the upper 95 percent confidence limit of the mean, UL95.
    (e) If the UL95 exceeds the maximum detected concentration, delete nondetects where the detection limit is greater than the maximum detected value.
2. Determine the percentage of nondetects in the database, %nd.
3. If %nd < 15 apply parametric one way analysis of variance (t test) using normal or log transformed data as determined in steps 1(c) and (d).
4. If 15 < %nd < 50, apply Wilcoxon rank sum test or equivalent (e.g., Mann-Whitney U test).
5. If %nd > 50, apply Method of Proportions (EPA, 1989b).

In each of the tests described in steps 3 through 5 a significance level, p, of 0.1 will be used.

This procedure, although somewhat complicated, has several advantages over alternative, but somewhat simpler, methods that may also be appropriate to the data. The advantages of this method are:

- It is completely consistent with USEPA guidance (EPA, 1989a; EPA, 1989b);
- It is robust, (i.e., it is valid for most plausible data sets). Data sets for which this method is technically invalid are small data sets with a low total number of hits (less than 5). In that case the decision criteria result in selection of the Method of Proportions, but the Method of Proportions is not technically valid under these conditions.

These methods are designed to determine if the mean of the study area data set is significantly greater than the mean of the background data set. If so, the constituent would be a COPC for that study area and included in the quantitative BRA.

The hypothesis tested by these methods is directly relevant to exposure assessment, which is based on a conservative estimate (upper 95 percent confidence limit) of the mean exposure concentration. These methods are less relevant for the identification of small hot spots of contamination that may only affect one or a few samples. To redress the potential concern that hot spots of contamination may be overlooked by application of these statistical procedures, these results will be reviewed in the context of the upper tolerance limit test results conducted during the screening level analysis. Specifically, if a constituent exceeded the upper tolerance limit, but its mean was not significantly elevated above background, data for this constituent will be reviewed to determine if the exceedance was the result of hot spot contamination. If so, the constituent would be retained as a COPC.

The upper tolerance limit test is more sensitive to hot spots, although it can be subject to false positives if the study area data set has a large number of samples. Only one or a few samples may exceed the upper tolerance limit as a result of the natural variability in background concentrations even though the study area may be unaffected by mission activities. Factors to be considered in evaluation of the presence of hot spots, and inclusion as a COPC for that reason, will include:

- spatial correlation of elevated samples;
- relative magnitude of exceedance of the upper tolerance limit (i.e., 10 percent higher or 100 times higher);
- other evidence of mission activity at the elevated sampling locations; and
- whether the constituent is known to be associated with mission activities conducted at the study area.

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